Machinery Messages

Case History

Innovative online monitoring reduces maintenance costs

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Bently Nevada's Trendmaster® 2000 for Windows System was initially installed at the Anclote Power plant, located 25 miles northwest of Tampa, Florida during 1992. At that time, the system monitored 24 Cooling Tower Fan Gearboxes, located 1500 feet away from the plant. The Trendmaster 2000 System was selected, as it was cost-effective to run a single data cable to a remote location. Prior to the installation, manual monthly vibration readings had to be scheduled at considerable cost and inconvenience. Benefits were quickly realized. Data collected from the initial system startup was used to identify gear misalignment on the 1-1 Fan gearbox.

Operations, Maintenance and Engineering personnel were pleased with the installation, operation and results achieved from the Trendmaster 2000 System and decided to expand the system to include other balance-of-plant (BOP) equipment. The philosophy used was to install Trendmaster 2000 equipment on individual plant systems, one system at a time, as funds became available. During the past four years, the Trendmaster 2000 System has been expanded to include the plant's Forced Draft Fans, Fuel Oil Burner Pumps, Circulating Water Pumps, Condensate Pumps, Boiler Circulating Pumps, Fuel Oil Booster Pumps, Cooling Tower Pumps, Chemical Feed Pump, Gas Recirculation Fans and Dilution Pumps. A total of 211 points are being monitored, covering virtually all of the large (4160 volt) BOP equipment.

Underwater transducers

One challenging application was monitoring the plant's Circulating Water Pumps. These pumps are 681,900 liters per minute (150,000 gpm), vertical, saltwater pumps. They have sleeve bearings and operate at 290 rpm. The main problem was determining the condition of the lower sleeve bearing and impeller, which are underwater. Monitoring the motor bearings and pump stuffing box does not help predict lower pump bearing failure until it is too late. These pumps weigh approximately 36,300 kg (40 tons), and removal is not an easy task. A waterproof transducer was needed, which could be easily mounted underwater at the lower bearing.

The solution was to mount a Bently Nevada 86205 Velocity Seismoprobe® and to connect it to the Transducer Interface Module (TIM), located on the pump deck, using Underwater Communication cable used by divers. After connecting the cable to the transducer, the transducer cap was injected with a marine sealant, which would make sure saltwater would not affect the connection. The polyphylene sulfide transducer case would not be affected by the saltwater. Instead of trying to machine the pump casing underwater, divers glued the transducer to the case using underwater epoxy.

This procedure resulted in an inexpensive, disposable transducer, which would allow us to trend and analyze vibration at the bearing and impeller area. Subsequent tests were run, using a Bently 89129 Accelerometer. The transducer is performing well.

Figure 1 shows Trendmaster 2000 trend and spectrum plots of the Circulating Water Pump taken on September 12, 1995. It indicates a gradual increase in pump vibration amplitudes over a seven month period. The spectrum plot shows a typical 1X rpm for these pumps. The vane pass frequency (2X rpm) is normally approximately one third the magnitude of the 1X rpm. These two plots indicated that the sleeve bearing, which was made of a composite material, was starting to enlarge, allowing the impeller to rotate closer to the pump housing. The next scheduled maintenance outage was in February 1996. It was decided, based on the gradual increase in vibration amplitude, that the pump would operate until the outage. When the pump was inspected in February, severe wear had occurred on the lower bearing, but the pump was otherwise undamaged. Without the Trendmaster 2000 machine information, the pump would not have been inspected until plant operators felt the "rumbling" on the waterfront deck, which would have meant complete bearing failure.

Trendmaster 2000 DCS Interface

Plant operators had requested that the Trendmaster 2000 alarms be displayed on the main plant's process computer, which was located in the control room. A Bailey Infi-90 DCS System was installed in the Anclote Control Room in 1994. Later, Bently Nevada Trendmaster 2000 DCS Interface Software became available and was installed in 1995. Requirements for the Bailey-Bently interface included: a serial buffer card for the Trendmaster 2000 computer, the Bently Nevada DCS Interface Software, Bailey Modbus®* Protocol Interface software, a Bailey MFP02 Module and RS 232 cable. The interface was successfully arranged with the help of Bently Nevada's Engineering Department in Minden, Nevada. Trendmaster 2000 Alert and Danger alarms are now displayed on the plant DCS alarm screens and individual amplitude readings are displayed on the plant's System Graphic Displays.

1900/25 Vibration Monitors

Another useful product offered by Bently Nevada is the 1900/25 Vibration Monitor. When the Trendmaster 2000 System was installed on the plant's Gas Recirculation Fans, one of the requirements was that a local alarm device be added, which would be activated upon high vibration. The 1900/25 Monitor provided a convenient way to include an adjustable alarm module, a local vibration amplitude display and a connection to the Trendmaster 2000 System. The only concern was whether the module would be susceptible to RF Interference. To alleviate these concerns, the modules were mounted in a shielded junction box with a glass window, so the displays could be easily seen by plant operators. Operators can now "key" their radios near the 1900/25 without fear of causing alarms which would "trip" the Gas Recirculation Fans.

Several different vibration alarm switches, which were installed during the last twenty-two years as part of OEM equipment, are used throughout the plant. Standardizing on the 1900/25 Monitor will allow the plant to reduce its spare part inventory and allow additional points to be monitored by Operations, using Trendmaster 2000.

3300 System Turbine Supervisory Instrumentation

The Trendmaster 2000 System complements our existing 3300 System Turbine Supervisory Instrumentation (TSI) System, which is installed on both of the plant's two 525 MW turbine generators and four steam-driven, Boiler Feed Pumps. Operations and Maintenance personnel only need to interpret Bently Nevada terminology, compared to trying to learn machine and alarm terminology in different engineering units supplied by different vendors. The Bently Nevada Transient Data Manager®, which was interfaced to the 3300 TSI System, operated on a separate computer than the Trendmaster 2000 System. Finding space for two separate computers was a slight problem, since many personal computers were located in the Control Room to operate various new plant systems. In December 1996, the TDM System was upgraded to a Data Manager® 2000 for Windows NT™ System; the Trendmaster 2000 System was upgraded to a Trendmaster for Windows System. Both were loaded on a single computer operating on a standard Windows NT platform.

Costs versus benefits

Total dollar savings in the past four years, that can be attributed to the Trendmaster 2000 System, is difficult to estimate. It would realistically be approx. $200,000. If estimates were based on total rotating equipment failure, the savings would be approximately $500,000. An additional $20,000 per year was also saved by eliminating the need for a monthly vibration contractor.

Total installed costs are estimated at approximately $750 per monitored point or $150,000 for the complete system. Maintenance costs for the Trendmaster 2000 System have been approx. $2,000 per year, which was very little, considering the number of machine saves.

Machine saves

Many machine saves have been attributed to the System. They include unbalance on the Forced Draft Fans and Condensate Pumps, misalignment on the Fuel Oil Burner Pumps and Motors, gearmesh problems on the Cooling Tower Fan Gearboxes, and a bearing failure on the Circulating Water Pumps. Many managers only look for high profile, high dollar machine "saves" to determine the worth of a predictive maintenance tool. What is equally important is using the tool to minimize preventive maintenance by performing maintenance on equipment that truly needs it rather than basing it on a repetitive schedule. A complete evaluation of trend and spectrum plots before each maintenance outage, helps determine where maintenance should be performed.

Trendmaster 2000 and other Bently Nevada products have provided valuable machinery information to plant engineers and operators. Trendmaster 2000 is a cost-effective, automatic data collection system. This is extremely important in an era of utility deregulation and budget cutbacks. It is an integral part of both the operations and maintenance functions at Florida Power's Anclote Plant. ■

*Modbus® is a registered trademark of Modicon, Inc.

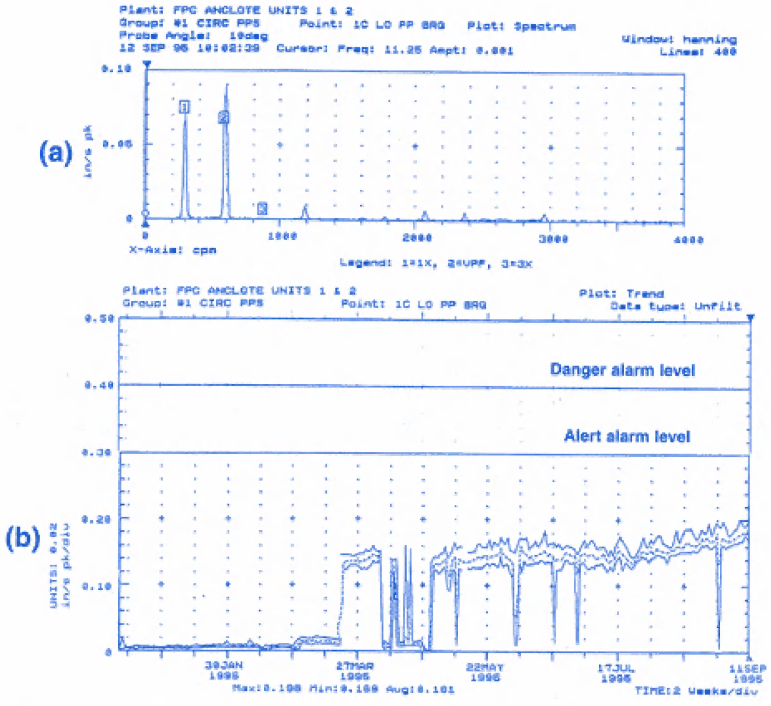

Figure 1
(a) Spectrum plot showing peaks at 290 cpm and 580 cpm.
(b) Circulating water pump trend plot showing gradual vibration increase.